

WHAT IS CLAIMED IS:

- 1 1. A method of forming a traction drive rolling element  
2 including a traction surface which has microscopic crowned-  
3 projections, the method comprising:  
4 forming a workpiece into a preform having a central axis  
5 and a working surface having an arcuate profile in cross  
6 section taken along the central axis;  
7 supporting the preform so as to be rotatable about the  
8 central axis;  
9 allowing a relative movement between the preform and a  
10 grooving tool such that the grooving tool is moved along the  
11 arcuate profile of the working surface, simultaneously with  
12 rotating the preform about the central axis, to thereby form  
13 a plurality of microscopic recesses and microscopic  
14 projections alternately arranged in a direction  
15 perpendicular to the central axis along the arcuate profile;  
16 pressing a grindstone on the working surface of the  
17 preform, the grindstone having a contact surface area of not  
18 more than 25 mm<sup>2</sup> in which the grindstone is contacted with  
19 the working surface; and  
20 allowing a relative movement between the preform and the  
21 grindstone such that the grindstone is moved along the  
22 arcuate profile of the working surface simultaneously with  
23 rotating the preform about the central axis while keeping  
24 pressing the grindstone on the working surface until a  
25 height of the microscopic projections becomes not more than  
26 3 µm, to thereby form the traction drive rolling element  
27 including the traction surface having the microscopic  
28 crowned-projection.
- 1 2. The method as claimed in claim 1, wherein the traction  
2 drive rolling element is at least one of an input disk and

3 an output disk cooperating with a power roller to constitute  
4 a traction drive transmission.

1 3. The method as claimed in claim 2, wherein the  
2 microscopic recesses and microscopic projections are formed  
3 in a predetermined region of the working surface which  
4 extends in opposite directions at an angle of  $\pm 15$  degrees as  
5 taken around a center of curvature of the arcuate profile of  
6 the working surface of the preform relative to a line  
7 extending from the center of curvature of the arcuate  
8 profile to a point where the input and output disks are in  
9 contact with the power roller to set a rotational speed  
10 ratio between the input disk and the output disk at 1.2:1.

1 4. The method as claimed in claim 2, wherein the  
2 microscopic recesses and microscopic projections are formed  
3 in a predetermined region of the working surface of the  
4 preform for the input disk which extends at an angle ranging  
5 from 40 degrees to 70 degrees as taken around a center of  
6 curvature of the arcuate profile relative to a line  
7 extending perpendicular to the central axis and passing  
8 through the center of curvature of the arcuate profile, and  
9 the microscopic recesses and microscopic projections are  
10 formed in a predetermined region of the working surface of  
11 the preform for the output disk which extends at an angle  
12 ranging from 55 degrees to 85 degrees as taken around the  
13 center of curvature of the arcuate profile relative to a  
14 line extending perpendicular to the central axis and passing  
15 through the center of curvature of the arcuate profile.

1 5. The method as claimed in claim 2, wherein a distance of  
2 the relative movement between the preform and the grooving

3 tool is in a range from 100 $\mu$ m to 300  $\mu$ m per one rotation of  
4 the preform.

1 6. The method as claimed in claim 2, wherein the relative  
2 movement between the preform and the grooving tool is made  
3 so as to adjust a height of the microscopic projections to a  
4 maximum value at a first point where the input and output  
5 disks are in contact with the power roller to set a  
6 rotational speed ratio between the input disk and the output  
7 disk at 1.2:1, and adjust the height thereof to not more  
8 than 0.5  $\mu$ m at second points which are positioned at  
9 opposite sides of the first point, and wherein a first line  
10 extending through the first point and a second line  
11 extending through each of the second points make an angle of  
12 15 degrees around the center of curvature of the arcuate  
13 profile.

1 7. The method as claimed in claim 6, wherein the height of  
2 the microscopic projections continuously decreases from the  
3 first point and the second point.

1 8. The method as claimed in claim 6, wherein the height of  
2 the microscopic projections is adjusted to not more than 3  
3  $\mu$ m.

1 9. The method as claimed in claim 6, wherein the height of  
2 the microscopic projections is adjusted to more than 3  $\mu$ m.

1 10. The method as claimed in claim 6, wherein the relative  
2 movement between the preform and the grooving tool is made  
3 so as to move the grooving tool along the arcuate profile of  
4 the working surface of the preform.

1 11. The method as claimed in claim 10, wherein the grooving  
2 tool is pivotally moveable about a pivot axis which is  
3 offset from the center of curvature of the arcuate profile  
4 of the working surface of the preform so as to approach the  
5 arcuate profile, the grooving tool having a radius of  
6 curvature of a locus of the pivotal movement which is  
7 smaller than a radius of curvature of the arcuate profile of  
8 the working surface of the preform.

1 12. The method as claimed in claim 2, wherein the grooving  
2 tool has a rounded end having a radius of curvature which  
3 ranges from 50  $\mu\text{m}$  to 100  $\mu\text{m}$ .

1 13. The method as claimed in claim 1, wherein the  
2 grindstone is pressed on the working surface of the preform  
3 at a force ranging from 50 N to 500 N.

1 14. The method as claimed in claim 1, wherein the relative  
2 movement between the preform and the grindstone is made so  
3 as to pivotally move the grindstone along the arcuate  
4 profile of the working surface of the preform.

1 15. The method as claimed in claim 1, wherein the  
2 grindstone has at least one protrusion which is formed on an  
3 outer periphery of the grindstone and brought into contact  
4 with the working surface of the preform.

1 16. The method as claimed in claim 15, wherein the  
2 grindstone has a plurality of protrusions which are formed  
3 on an outer periphery of the grindstone and brought into  
4 contact with the working surface of the preform.

1 17. The method as claimed in claim 16, wherein the relative  
2 movement between the preform and the grindstone is made so  
3 as to pivotally move the grindstone along the arcuate  
4 profile of the working surface of the preform, the  
5 grindstone having a pivot axis and a pivot angle at which  
6 the grindstone is pivotally moveable, the plurality of  
7 protrusions including three protrusions arranged in  
8 circumferentially spaced relation to each other on the outer  
9 periphery of the grindstone, the three protrusions including  
10 a middle protrusion and two opposed protrusions which are  
11 disposed on both sides of the middle protrusion and have  
12 central lines extending across the pivot axis of the  
13 grindstone, respectively, the central lines of the two  
14 opposed protrusions making an angle therebetween which  
15 ranges from an angle smaller by 10 degrees than the pivot  
16 angle of the grindstone to the pivot angle of the grindstone.

1 18. The method as claimed in claim 1, wherein the contact  
2 surface area of the grindstone ranges from 4 mm<sup>2</sup> to 16 mm<sup>2</sup>.

1 19. The method as claimed in claim 15, wherein the preform  
2 is rotated such that an average circumferential velocity at  
3 a contact point where the working surface of the preform and  
4 the grindstone are in contact with each other is in a range  
5 from 25 m/min to 350 m/min, and the grindstone is pivotally  
6 moved at a speed ranging from 5 cycles/min to 100 cycles/min.

1 20. The method as claimed in claim 15, wherein the  
2 protrusion of the grindstone has a compressive elastic  
3 modulus of not less than 1 GPa.

1 21. The method as claimed in claim 1, wherein the  
2 grindstone comprises abrasive grains having a particle size  
3 of smaller than No.1000.

1 22. The method as claimed in claim 1, wherein the relative  
2 movement between the preform and the grindstone is made so  
3 as to, when the grindstone is pivotally moved relative to  
4 the working surface, continuously changing the rotational  
5 speed of the working surface of the preform such that a  
6 circumferential velocity of the working surface at a contact  
7 point of the working surface relative to the grindstone is  
8 constant.

1 23. The method as claimed in claim 1, wherein the  
2 microscopic projection of the working surface of the preform  
3 is removed by a depth of not more than 5  $\mu\text{m}$  from an outer-  
4 most surface thereof.

1 24. A traction drive rolling element including a traction  
2 surface having microscopic crowned-projections formed by the  
3 method as claimed in claim 1, wherein the microscopic  
4 crowned-projections have a height of not more than 3  $\mu\text{m}$ .

1 25. A traction drive rolling element, comprising:  
2 a traction surface having an arcuate profile in cross  
3 section taken along a rotation axis; and  
4 microscopic crowned-projections disposed along the  
5 arcuate profile, the microscopic crowned-projections having  
6 a height of not more than 3  $\mu\text{m}$  and a rounded corner portion  
7 which has a radius of curvature ranging from 2 mm to 10 mm.